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\emph{Gaia} Early Data Release 3 peculiar velocity distribution of Galactic high-mass x-ray binaries

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High-mass X-ray binaries (HMXBs) are systems in which a neutron star or black hole accretes material from a massive companion. They can be roughly divided into three main classes: (i) wind-fed compact objects with supergiant donors; (ii) compact objects accreting from the decretion disc of a Be star; (iii) compact objects accreting via a disc from a Roche-lobe filling companion. All HMXBs must have experienced a core-collapse supernova event during their evolution. The kick associated with this event should affect the space velocity of the system in a way that depends on the state of the binary at the time of the explosion. Here, we test whether the different evolutionary histories of HMXBs have left a detectable imprint on their peculiar velocities. Using data from Gaia Early Data Release 3 (Gaia EDR3), we first calculate the peculiar velocities (V_p) and associated uncertainties for 55 well-known HMXBs. The peculiar velocity distribution shows some evidence for bimodality, suggesting the existence of two distinct populations: one characterised by low velocities ($< 50 \text{ km s}^{-1}$), the other characterised by high velocities ($> 50 \text{ km s}^{-1}$). The existence of a high-velocity population is surprising for such massive systems. We use Monte Carlo simulations to set firm lower limits on V_p for all of our targets, finding that at least 5 systems in our sample have $V_p > 75 \text{ km s}^{-1}$ at probability $(p) < 2e^{-5}$.

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